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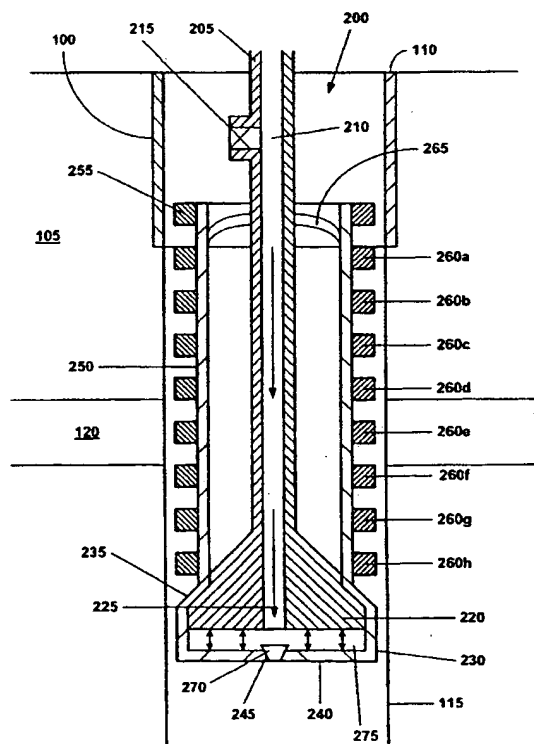
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(54) Title: LINER HANGER WITH STANDOFFS



(57) Abstract: An apparatus and method for forming or repairing a wellbore casing (110) by radially expanding a tubular liner (250) having standoffs (260a-h).

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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

• *Chlorophyll a*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

— with international search report

**LINER HANGER WITH STANDOFFS**  
**Cross Reference To Related Applications**

This application claims the benefit of the filing date of U.S. provisional patent application serial number 60/221,645, attorney docket number 25791.46, filed on 7/28/2000, the disclosure of which is  
5 incorporated herein by reference.

This application is related to the following co-pending applications:  
(1) U.S. patent application serial no. 09/440,338, attorney docket number 25791.9.02, filed on 11/15/1999, which claimed benefit of the filing date of U.S. provisional patent application serial number 60/108,558, attorney  
10 docket number 25791.9, filed on 11/16/1998, (2) U.S. patent application serial no. 09/454,139, attorney docket number 25791.3.02, filed on 12/3/1999, which claimed benefit of the filing date of U.S. provisional patent application serial number 60/111,293, filed on 12/7/1998, (3) U.S. patent application serial number 09/502,350, attorney docket number  
15 25791.8.02, filed on 2/10/2000, which claimed the benefit of the filing date of U.S. provisional patent application serial number 60/119,611, attorney docket number 25791.8, filed on 2/11/1999, (4) U.S. patent application serial number 09/510,913, attorney docket number 25791.7.02, filed on 2/23/2000, which claimed the benefit of the filing date of U.S. provisional patent application serial number 60/121,702, attorney docket number  
20 25791.7, filed on 2/25/1999, (5) U.S. patent application serial number 09/511,941, attorney docket number 25791.16.02, filed on 2/24/2000, which claimed the benefit of the filing date of U.S. provisional patent application number 60/121,907, attorney docket number 25791.16, filed on  
25 2/26/1999, (6) U.S. patent application serial number 09/523,460, attorney docket number 25791.11.02, filed on 3/10/2000, which claimed the benefit of the filing date of U.S. provisional patent application serial number 60/124,042, attorney docket number 25791.11, filed on 3/11/1999, (7) U.S. patent application serial number 09/559,122, attorney docket number  
30 25791.23.02, filed on 4/26/2000, which claimed the benefit of the filing date of U.S. provisional patent application serial number 60/131,106,

attorney docket number 25791.23, filed on 4/26/1999, (8) U.S. patent application serial number \_\_\_\_\_, attorney docket number 25791.17.02, filed on \_\_\_\_\_, which claimed the benefit of the filing date of U.S. provisional patent application serial number 60/137,998, attorney docket number 25791.17, filed on 6/7/1999, (9) U.S. provisional patent application serial number 60/143,039, attorney docket number 25791.26, filed on 7/9/1999, (10) U.S. provisional patent application serial number 60/146,203, attorney docket number 25791.25, filed on 7/29/1999, the disclosures of which are incorporated by reference; (11) U.S. provisional patent application serial number 60/183,546, attorney docket number 25791.10, filed on 2/18/2000; (12) U.S. patent application serial number 09/512,895, attorney docket number 25791.12.02, filed on 2/24/2000, which claimed the benefit of the filing date of U.S. provisional patent application serial number 60/121,841, attorney docket number 25791.12, filed on 2/26/1999; (13) U.S. provisional patent application serial number \_\_\_\_\_, attorney docket number 25791.38, filed on 6/19/2000; (14) U.S. provisional patent application serial number 60/162,671, attorney docket number 25791.27, filed on 11/1/1999; (15) U.S. provisional patent application serial number 60/159,039, attorney docket number 25791.36, filed on 10/12/1999; (16) U.S. provisional patent application serial number 60/159,033, attorney docket number 25791.37, filed on 10/12/1999; (17) U.S. provisional patent application serial number 60/165,228, attorney docket number 25791.39, filed on 11/12/1999; and (18) U.S. provisional patent application number \_\_\_\_\_, attorney docket number 25791.45, filed on \_\_\_\_\_, the disclosures of which are incorporated herein by reference.

#### Background of the Invention

This invention relates generally to wellbore casings, and in particular to wellbore casings that are formed using expandable tubing.

Conventionally, when a wellbore is created, a number of casings are installed in the borehole to prevent collapse of the borehole wall and to

prevent undesired outflow of drilling fluid into the formation or inflow of fluid from the formation into the borehole. The borehole is drilled in intervals whereby a casing which is to be installed in a lower borehole interval is lowered through a previously installed casing of an upper borehole interval. As a consequence of this procedure the casing of the lower interval is of smaller diameter than the casing of the upper interval. Thus, the casings are in a nested arrangement with casing diameters decreasing in downward direction. Cement annuli are provided between the outer surfaces of the casings and the borehole wall to seal the casings from the borehole wall. As a consequence of this nested arrangement a relatively large borehole diameter is required at the upper part of the wellbore. Such a large borehole diameter involves increased costs due to heavy casing handling equipment, large drill bits and increased volumes of drilling fluid and drill cuttings. Moreover, increased drilling rig time is involved due to required cement pumping, cement hardening, required equipment changes due to large variations in hole diameters drilled in the course of the well, and the large volume of cuttings drilled and removed.

The present invention is directed to overcoming one or more of the limitations of the existing procedures for forming wellbores and wellheads.

#### Summary of the Invention

According to one aspect of the present invention, a method of forming a casing in a wellbore having a cased section and an open hole section is provided that includes positioning a tubular liner within the wellbore, overlapping the tubular liner and the cased section, centering the tubular liner within the wellbore, and radially expanding the tubular liner into contact with the cased section.

According to another aspect of the present invention, a radially expandable tubular member for repairing an opening in a wellbore casing is provided that includes a tubular member, and one or more standoffs coupled to the exterior surface of the tubular member.

According to another aspect of the present invention, an apparatus for repairing an opening in a wellbore casing is provided that includes a tubular support member including a first passage, an expansion cone coupled to the tubular support member including a second passage  
5 fluidically coupled to the first passage, an expansion cone launcher coupled to the expansion cone including a shoe having an exhaust passage, and an expandable tubular member coupled to the expansion cone launcher including one or more standoffs.

According to another aspect of the present invention, an apparatus  
10 is provided that includes a wellbore including a preexisting casing and an open hole section, and a radially expanded tubular member coupled to the preexisting casing including one or more standoffs.

#### Brief Description of the Drawings

FIG. 1 is a cross-sectional view illustrating a wellbore including a  
15 wellbore casing and an open hole section that traverses a porous subterranean layer.

FIG. 2 is a fragmentary cross-sectional view illustrating the introduction of an apparatus for casing the open hole section of the wellbore of FIG. 1.

20 FIG. 3 is a fragmentary cross-sectional view illustrating the injection of a fluidic material into the apparatus of FIG. 2.

FIG. 4 is a fragmentary cross-sectional view illustrating the placement of a plug into the exhaust passage of the shoe of the apparatus of FIG. 3.

25 FIG. 5 is a fragmentary cross-sectional view illustrating the pressurization of the interior portion of the apparatus below the expansion cone of FIG. 4.

30 FIG. 6 is a fragmentary cross-sectional view illustrating the completion of the radial expansion of the tubular member of the apparatus of FIG. 5.

FIG. 7 is a fragmentary cross-sectional view illustrating the removal of the shoe from the apparatus of FIG. 6.

#### Detailed Description of the Illustrative Embodiments

An apparatus and method for casing an open hole section of a wellbore within a subterranean formation is provided. The apparatus and method provides a system for casing an open hole section of a wellbore within a subterranean formation in which a tubular member having a plurality of radially oriented standoffs is radially expanded into contact with the preexisting wellbore casing and the open hole section. The standoffs provided on the exterior surface of the tubular member preferably position the tubular member away from the interior walls of the open hole section during the radial expansion process. In this manner, the tubular member does not adhere to underpressurized sections of the open hole section of the wellbore. In this manner, the process of radial expansion is more reliable.

Referring initially to Fig. 1, a wellbore 100 positioned within a subterranean formation 105 includes a preexisting casing 110 and an open hole section 115 that traverses an porous region 120. When the operating pressure within the wellbore  $P_{\text{BORE}}$  is greater than the operating pressure within the porous region  $P_{\text{PORE}}$ , fluidic materials will flow from the wellbore 100 into the porous region 120. As a result of the flow of fluidic materials from the wellbore 100 into the porous region 120, downhole equipment will tend to adhere to, or at least be drawn toward, the interior surface of the wellbore 100 in the vicinity of the porous region 120. This can have serious and adverse consequences when radially expanding a tubular member in such an operating environment.

Referring to Fig. 2, an apparatus 200 for forming a wellbore casing in the open hole section of the wellbore 100 may then be positioned within the wellbore in an overlapping relationship with the lower portion of the preexisting wellbore casing 110.

The apparatus 200 includes a tubular support member 205 having a longitudinal passage 210 and a transverse passage 215 that is coupled to an expansion cone 220 having a longitudinal passage 225 that is fluidically coupled to the longitudinal passage 210. The expansion cone 220 is at least partially received within an expansion cone launcher 230 that includes a thin-walled annular member 235 and a shoe 240 having an exhaust passage 245. An expandable tubular member 250 extends from the expansion cone launcher 230 that includes a sealing member 255 and a plurality of standoffs 260a-260h affixed to the exterior surface of the expandable tubular member. In a preferred embodiment, the standoffs 260 are fabricated from a resilient material. A sealing cup 265 is attached to the exterior surface of the tubular support member 205 for preventing foreign materials from entering the interior of the expandable tubular member 250.

In a preferred embodiment, the apparatus 200 is provided as disclosed in one or more of the following: (1) U.S. patent application serial no. 09/440,338, attorney docket number 25791.9.02, filed on 11/15/1999, which claimed benefit of the filing date of U.S. provisional patent application serial number 60/108,558, attorney docket number 25791.9, filed on 11/16/1998, (2) U.S. patent application serial no. 09/454,139, attorney docket number 25791.3.02, filed on 12/3/1999, which claimed benefit of the filing date of U.S. provisional patent application serial number 60/111,293, filed on 12/7/1998, (3) U.S. patent application serial number 09/502,350, attorney docket number 25791.8.02, filed on 2/10/2000, which claimed the benefit of the filing date of U.S. provisional patent application serial number 60/119,611, attorney docket number 25791.8, filed on 2/11/1999, (4) U.S. patent application serial number 09/510,913, attorney docket number 25791.7.02, filed on 2/23/2000, which claimed the benefit of the filing date of U.S. provisional patent application serial number 60/121,702, attorney docket number 25791.7, filed on 2/25/1999, (5) U.S. patent application serial number 09/511,941, attorney



docket number 25791.16.02, filed on 2/24/2000, which claimed the benefit of the filing date of U.S. provisional patent application number 60/121,907, attorney docket number 25791.16, filed on 2/26/1999, (6) U.S. patent application serial number 09/523,460, attorney docket number

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10 25791.23.02, filed on 4/26/2000, which claimed the benefit of the filing date of U.S. provisional patent application serial number 60/131,106, attorney docket number 25791.23, filed on 4/26/1999, (8) U.S. patent application serial number \_\_\_\_\_, attorney docket number

15 25791.17.02, filed on \_\_\_\_\_, which claimed the benefit of the filing date of U.S. provisional patent application serial number 60/137,998, attorney docket number 25791.17, filed on 6/7/1999, (9) U.S. provisional patent application serial number 60/143,039, attorney docket number

20 25791.26, filed on 7/9/1999, (10) U.S. provisional patent application serial number 60/146,203, attorney docket number 25791.25, filed on 7/29/1999, the disclosures of which are incorporated by reference; (11) U.S. provisional patent application serial number 60/183,546, attorney docket

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30 25791.12, filed on 2/26/1999; (13) U.S. provisional patent application serial number \_\_\_\_\_, attorney docket number 25791.38, filed on 6/19/2000; (14) U.S. provisional patent application serial number 60/162,671, attorney docket number 25791.27, filed on 11/1/1999; (15) U.S. provisional patent application serial number 60/159,039, attorney docket

number 25791.36, filed on 10/12/1999; (16) U.S. provisional patent application serial number 60/159,033, attorney docket number 25791.37,

filed on 10/12/1999; and (17) U.S. provisional patent application serial number 60/165,228, attorney docket number 25791.39, filed on 11/12/1999, the disclosures of which are incorporated herein by reference.

As illustrated in Fig. 2, during placement of the apparatus 200 within the wellbore 100, fluidic materials displaced by the apparatus 200 are conveyed through the longitudinal passages 210 and 225 to the transverse passage 215. In this manner, surge pressures during the placement of the apparatus 200 within the wellbore 100 are minimized. Furthermore, as illustrated in Fig. 2, the apparatus 200 is preferably initially positioned with upper portion of the tubular member 250 in opposing relation to the lower portion of the preexisting wellbore casing 110. In this manner, the upper portion of the tubular member 250 may be radially expanded into contact with the lower portion of the preexisting wellbore casing 110. In a preferred embodiment, during the placement of the apparatus 200 within the wellbore 100, the standoffs 260a-260h prevent the apparatus 200 from adhering to, or being drawn toward, the interior surface of the wellbore 100 in the vicinity of the porous region 120. In this manner, the apparatus 200 is approximately centered within the wellbore 100.

As illustrated in Fig. 3, the transverse passage 215 may then be closed and fluidic materials injected into the apparatus 200 through the longitudinal passage 210. In this manner, any blockages within any of the passages 210, 225, and 245 may be detected by monitoring the operating pressure whereby an increase in operating pressure above nominal, or predetermined, conditions may indicate a blockage of one of the passages.

As illustrated in Fig. 4, a plug 270 or other conventional stop member may then be introduced into the fluidic materials injected into the apparatus 200 through the passage 210, and the plug 270 may be positioned within the exhaust passage 245. In this manner, the exhaust passage 245 may be sealed off. Thus, continued injection of fluidic

materials into the apparatus 200 through the passage 210 may thereby pressurize a region 275 below the expansion cone 220.

As illustrated in Figs. 5 and 6, continued pressurization of the region 275 causes the expansion cone 220 to radially expand the expandable tubular member 250 off of the expansion cone. In this manner, the upper portion of the radially expanded tubular member 250 is coupled to the lower portion of the preexisting wellbore casing 110. In a preferred embodiment, during the radial expansion process, the tubular support member 205 is raised out of the wellbore 100.

In a preferred embodiment, throughout the radial expansion process, the standoffs 260a-260h prevent the exterior surface of the apparatus 200 from adhering to, or being drawn toward, the interior surface of the wellbore 100 in the vicinity of the porous region 120. In this manner, the apparatus 200 is preferably substantially centered within the wellbore 100. Furthermore, in this manner, the longitudinal center axis of the expansion cone 220 is preferably maintained in a position that is substantially coincident with the longitudinal center axis of the tubular member 250. In addition, in this manner, the stresses applied to the interior surface of the tubular member 250 by the axial displacement of the expansion cone 220 are substantially even. Finally, in this manner, overstressing of the tubular member 250 is prevented thereby eliminating catastrophic failure of the tubular member 250.

As illustrated in Fig. 7, the shoe 240 may then be removed using a conventional milling device.

In a preferred embodiment, upon radially expanding the expandable tubular member 250, the standoffs 260a-260h seal and isolate intervals within the open hole section 115. In several alternative embodiments, the standoffs 260 may be provided, for example, by annular members spaced along the length of the expandable tubular member 250 and/or a continuous member that is wrapped around the expandable tubular member 250 in helical fashion.

It is understood that variations may be made in the foregoing without departing from the scope of the invention. For example, the apparatus 200 may be used to form and/or repair, for example, a wellbore casing, a pipeline, or a structural support.

5           Although illustrative embodiments of the invention have been shown and described, a wide range of modification, changes and substitution is contemplated in the foregoing disclosure. In some instances, some features of the present invention may be employed without a corresponding use of the other features. Accordingly, it is  
10           appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the invention.

## Claims

What is claimed is:

- 1     1.     A method of forming a casing in a wellbore having a cased section  
2     and an open hole section, comprising:  
3         positioning a tubular liner within the wellbore;  
4         overlapping the tubular liner and the cased section;  
5         centering the tubular liner within the wellbore; and  
6         radially expanding the tubular liner into contact with the cased  
7         section.
- 8     2.     The method of claim 1, wherein centering comprises:  
9         preventing the tubular liner from adhering to the open hole section  
10         of the wellbore.
- 1     3.     A radially expandable tubular member for repairing an opening in  
2     a wellbore casing, comprising:  
3         a tubular member; and  
4         one or more standoffs coupled to the exterior surface of the tubular  
5         member.
- 1     4.     An apparatus for repairing an opening in a wellbore casing,  
2     comprising:  
3         a tubular support member comprising a first passage;  
4         an expansion cone coupled to the tubular support member  
5             comprising a second passage fluidically coupled to the first  
6             passage;  
7         an expansion cone launcher coupled to the expansion cone  
8             comprising a shoe having an exhaust passage; and  
9         an expandable tubular member coupled to the expansion cone  
10         launcher comprising one or more standoffs.

- 1     5.     An apparatus, comprising:  
2             a wellbore comprising a preexisting casing and an open hole section;  
3             and  
4             a radially expanded tubular member coupled to the preexisting  
5             casing comprising one or more standoffs.
- 1     6.     A system for forming a casing in a wellbore having a cased section  
2     and an open hole section, comprising:  
3             means for positioning a tubular liner within the wellbore;  
4             means for overlapping the tubular liner and the cased section;  
5             means for centering the tubular liner within the wellbore; and  
6             means for radially expanding the tubular liner into contact with the  
7             cased section.
- 1     7.     The system of claim 6, wherein the means for centering comprises:  
2             means for preventing the tubular liner from adhering to the open  
3             hole section of the wellbore.

## AMENDED CLAIMS

[received by the International Bureau on 16 January 2002 (16.01.02);  
original claims 1-7 cancelled; claims 8-19 added (7 pages)]

1 5. [DELETED]

1 6. [DELETED]

1 7. [DELETED]

1 8. In a wellbore that traverses a subterranean formation and includes a cased  
2 section having a wellbore casing and an uncased section that traverses a porous  
3 subterranean zone, wherein the operating pressure of the wellbore is greater than  
4 the operating pressure of the porous subterranean zone, a method of coupling a  
5 tubular liner to the wellbore casing of the cased section of the wellbore,  
6 comprising:

7 positioning a solid tubular liner and an expansion cone within the wellbore

8 with the solid tubular liner overlapping the wellbore casing;

9 during the positioning of the solid tubular liner within the wellbore,

10 preventing the portion of the solid tubular liner that does not

11 overlap with the wellbore casing from contacting the porous

12 subterranean zone of the uncased section of the wellbore;

13 radially expanding the solid tubular liner by injecting a fluidic material

14 into the tubular liner to pressurize the interior of the solid tubular

15 liner and displace the expansion cone relative to the solid tubular

16 liner; and

17 preventing the portion of the solid tubular liner that does not overlap with

18 the wellbore casing from contacting the porous subterranean zone

19 of the uncased section of the wellbore during the radial expansion of

20 the portion of the solid tubular liner that does not overlap with the

21 wellbore casing.

1 9. The method of claim 8, further comprising:

2 during the positioning of the solid tubular liner within the wellbore,

3 preventing the portion of the solid tubular liner that does not

4 overlap with the wellbore casing from adhering to the porous

5 subterranean zone of the uncased section of the wellbore; and

6 preventing the portion of the solid tubular liner that does not overlap with  
7 the wellbore casing from adhering to the porous subterranean zone  
8 of the uncased section of the wellbore during the radial expansion of  
9 the portion of the solid tubular liner that does not overlap with the  
10 wellbore casing.

1 10. In a wellbore that traverses a subterranean formation, the wellbore  
2 including a cased section having a wellbore casing and an uncased section, a  
3 method of coupling a tubular liner to the wellbore casing of the cased section of  
4 the wellbore, comprising:  
5 positioning a solid tubular liner and an expansion cone within the wellbore  
6 with the solid tubular liner overlapping the wellbore casing;  
7 during the positioning of the portion of the solid tubular liner that does not  
8 overlap with the wellbore casing within the wellbore, maintaining  
9 the longitudinal center line of the expansion cone in a position that  
10 is substantially coincident with the longitudinal center line of the  
11 portion of the solid tubular liner that does not overlap with the  
12 wellbore casing;  
13 radially expanding the solid tubular liner by injecting a fluidic material  
14 into the tubular liner to pressurize the interior of the solid tubular  
15 liner and displace the expansion cone relative to the solid tubular  
16 liner; and  
17 maintaining the longitudinal center line of the expansion cone in a position  
18 that is substantially coincident with the longitudinal center line of  
19 the portion of the solid tubular liner that does not overlap with the  
20 wellbore casing during the radial expansion of the portion of the  
21 solid tubular liner that does not overlap with the wellbore casing.

1 11. In a wellbore that traverses a subterranean formation, the wellbore  
2 including a cased section having a wellbore casing and an uncased section, a  
3 method of coupling a tubular liner to the wellbore casing of the cased section of  
4 the wellbore, comprising:  
5 positioning a solid tubular liner and an expansion cone within the wellbore;  
6 overlapping a portion of the solid tubular liner with the wellbore casing;



7 radially expanding the solid tubular liner by injecting a fluidic material  
8 into the tubular liner to pressurize the interior of the solid tubular  
9 liner and displace the expansion cone relative to the solid tubular  
10 liner; and  
11 during the radial expansion of the portion of the solid tubular liner that  
12 does not overlap with the wellbore casing, applying substantially  
13 equal stresses to the interior surface of the portion of the solid  
14 tubular liner that does not overlap with the wellbore casing using  
15 the expansion cone.

1 12. In a wellbore that traverses a subterranean formation and includes a cased  
2 section having a wellbore casing and an uncased section that traverses a porous  
3 subterranean zone, wherein the operating pressure of the wellbore is greater than  
4 the operating pressure of the porous subterranean zone, a system for coupling a  
5 tubular liner to the wellbore casing of the cased section of the wellbore,  
6 comprising:  
7 means for positioning a solid tubular liner and an expansion cone within  
8 the wellbore with the solid tubular liner overlapping the wellbore  
9 casing;  
10 means for during the positioning of the solid tubular liner within the  
11 wellbore, preventing the portion of the solid tubular liner that does  
12 not overlap with the wellbore casing from contacting the porous  
13 subterranean zone of the uncased section of the wellbore;  
14 means for radially expanding the solid tubular liner by injecting a fluidic  
15 material into the tubular liner to pressurize the interior of the solid  
16 tubular liner and displace the expansion cone relative to the solid  
17 tubular liner; and  
18 means for preventing the portion of the solid tubular liner that does not  
19 overlap with the wellbore casing from contacting the porous  
20 subterranean zone of the uncased section of the wellbore during the  
21 radial expansion of the portion of the solid tubular liner that does  
22 not overlap with the wellbore casing.

- 1     13.   The system of claim 12, further comprising:  
2           means for during the positioning of the solid tubular liner within the  
3           wellbore, preventing the portion of the solid tubular liner that does  
4           not overlap with the wellbore casing from adhering to the porous  
5           subterranean zone of the uncased section of the wellbore; and  
6           means for preventing the portion of the solid tubular liner that does not  
7           overlap with the wellbore casing from adhering to the porous  
8           subterranean zone of the uncased section of the wellbore during the  
9           radial expansion of the portion of the solid tubular liner that does  
10          not overlap with the wellbore casing.
- 1     14.   In a wellbore that traverses a subterranean formation, the wellbore  
2     including a cased section having a wellbore casing and an uncased section, a  
3     system for coupling a tubular liner to the wellbore casing of the cased section of  
4     the wellbore, comprising:  
5           means for positioning a solid tubular liner and an expansion cone within  
6           the wellbore with the solid tubular liner overlapping the wellbore  
7           casing;  
8           means for during the positioning of the portion of the solid tubular liner  
9           that does not overlap with the wellbore casing within the wellbore,  
10          maintaining the longitudinal center line of the expansion cone in a  
11          position that is substantially coincident with the longitudinal center  
12          line of the portion of the solid tubular liner that does not overlap  
13          with the wellbore casing;  
14          means for radially expanding the solid tubular liner by injecting a fluidic  
15          material into the tubular liner to pressurize the interior of the solid  
16          tubular liner and displace the expansion cone relative to the solid  
17          tubular liner; and  
18          means for maintaining the longitudinal center line of the expansion cone in  
19          a position that is substantially coincident with the longitudinal  
20          center line of the portion of the solid tubular liner that does not  
21          overlap with the wellbore casing during the radial expansion of the  
22          portion of the solid tubular liner that does not overlap with the  
23          wellbore casing.

- 1     15.     In a wellbore that traverses a subterranean formation, the wellbore  
2     including a cased section having a wellbore casing and an uncased section, a  
3     system for coupling a tubular liner to the wellbore casing of the cased section of  
4     the wellbore, comprising:  
5         positioning a solid tubular liner and an expansion cone within the wellbore;  
6         overlapping a portion of the solid tubular liner with the wellbore casing;  
7         radially expanding the solid tubular liner by injecting a fluidic material  
8             into the tubular liner to pressurize the interior of the solid tubular  
9             liner and displace the expansion cone relative to the solid tubular  
10            liner; and  
11         during the radial expansion of the portion of the solid tubular liner that  
12             does not overlap with the wellbore casing, applying substantially  
13             equal stresses to the interior surface of the portion of the solid  
14             tubular liner that does not overlap with the wellbore casing using  
15             the expansion cone.
- 1     16.     An apparatus for coupling a tubular liner to a wellbore casing within a  
2     wellbore that traverses a porous subterranean formation, comprising:  
3         a tubular support member defining a first internal passage;  
4         an expansion cone coupled to the tubular support member defining a  
5             second internal passage fluidically coupled to the first internal  
6             passage;  
7         a tubular expansion cone launcher movably coupled to and mating with the  
8             expansion cone;  
9         a solid tubular liner coupled to an end of the tubular expansion cone  
10            launcher; and  
11         a shoe coupled to another end of the tubular expansion cone launcher  
12             including a valveable passage;  
13         means for during a positioning of the solid tubular liner within the  
14             wellbore, preventing a portion of the solid tubular liner that does  
15             not overlap with the wellbore casing from contacting the porous  
16             subterranean zone of the wellbore; and

17 means for preventing the portion of the solid tubular liner that does not  
18 overlap with the wellbore casing from contacting the porous  
19 subterranean zone of the wellbore during a radial expansion of the  
20 portion of the solid tubular liner that does not overlap with the  
21 wellbore casing.

1 17. The apparatus of claim 16, further comprising:  
2 means for during the positioning of the solid tubular liner within the  
3 wellbore, preventing the portion of the solid tubular liner that does  
4 not overlap with the wellbore casing from adhering to the porous  
5 subterranean zone of the wellbore; and  
6 means for preventing the portion of the solid tubular liner that does not  
7 overlap with the wellbore casing from adhering to the porous  
8 subterranean zone of the wellbore during the radial expansion of  
9 the portion of the solid tubular liner that does not overlap with the  
10 wellbore casing.

1 18. An apparatus for coupling a tubular liner to a wellbore casing within a  
2 wellbore, comprising:  
3 a tubular support member defining a first internal passage;  
4 an expansion cone coupled to the tubular support member defining a  
5 second internal passage fluidically coupled to the first internal  
6 passage;  
7 a tubular expansion cone launcher movably coupled to and mating with the  
8 expansion cone;  
9 a tubular liner coupled to an end of the tubular expansion cone launcher;  
10 and  
11 a shoe coupled to another end of the tubular expansion cone launcher  
12 including a valveable passage; and  
13 means for during a positioning of a portion of the solid tubular liner that  
14 does not overlap with the wellbore casing within the wellbore,  
15 maintaining a longitudinal center line of the expansion cone in a  
16 position that is substantially coincident with a longitudinal center

17 line of the portion of the solid tubular liner that does not overlap  
18 with the wellbore casing;  
19 means for maintaining the longitudinal center line of the expansion cone in  
20 a position that is substantially coincident with the longitudinal  
21 center line of the solid tubular liner during a longitudinal  
22 displacement of the expansion cone relate to the tubular liner.

1 19. An apparatus for coupling a tubular liner to a wellbore casing within a  
2 wellbore, comprising:  
3 a tubular support member defining a first internal passage;  
4 an expansion cone coupled to the tubular support member defining a  
5 second internal passage fluidically coupled to the first internal  
6 passage;  
7 a tubular expansion cone launcher movably coupled to and mating with the  
8 expansion cone;  
9 a tubular liner coupled to an end of the tubular expansion cone launcher;  
10 and  
11 a shoe coupled to another end of the tubular expansion cone launcher  
12 including a valveable passage; and  
13 means for during a radial expansion of a portion of the solid tubular liner  
14 that does not overlap with the wellbore casing, applying  
15 substantially equal stresses to the interior surface of the portion of  
16 the solid tubular liner that does not overlap with the wellbore  
17 casing using the expansion cone.

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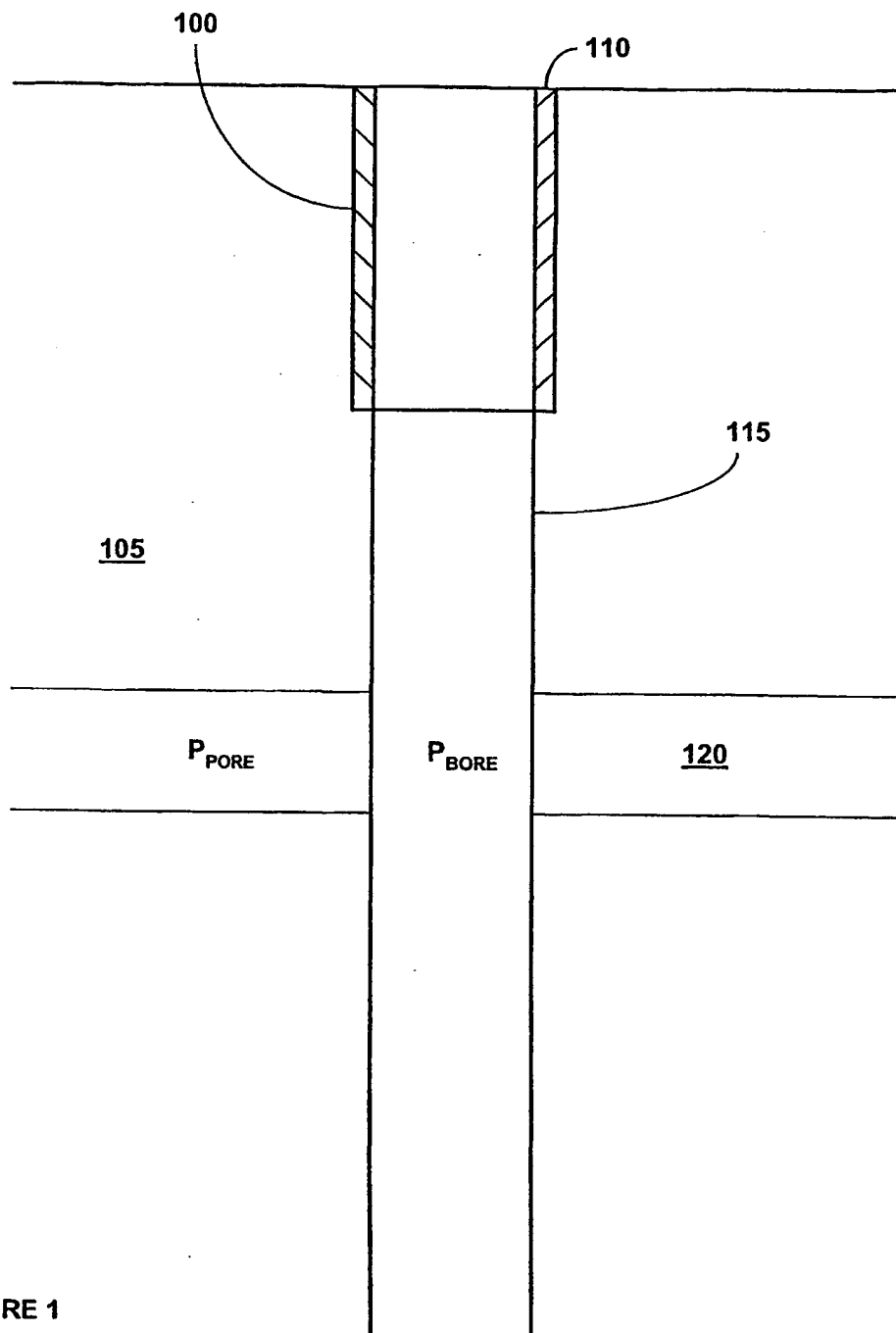
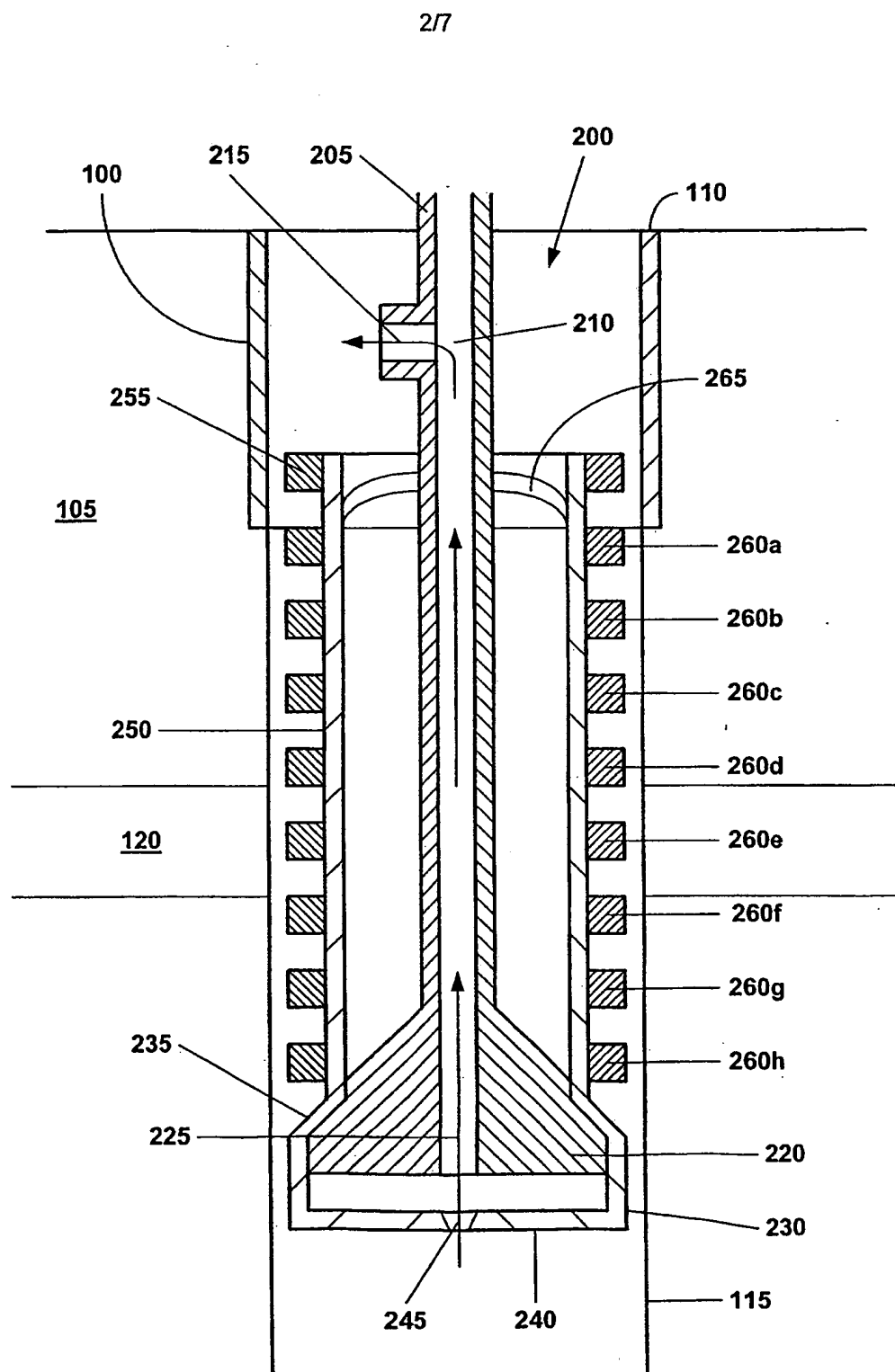


FIGURE 1



**FIGURE 2**





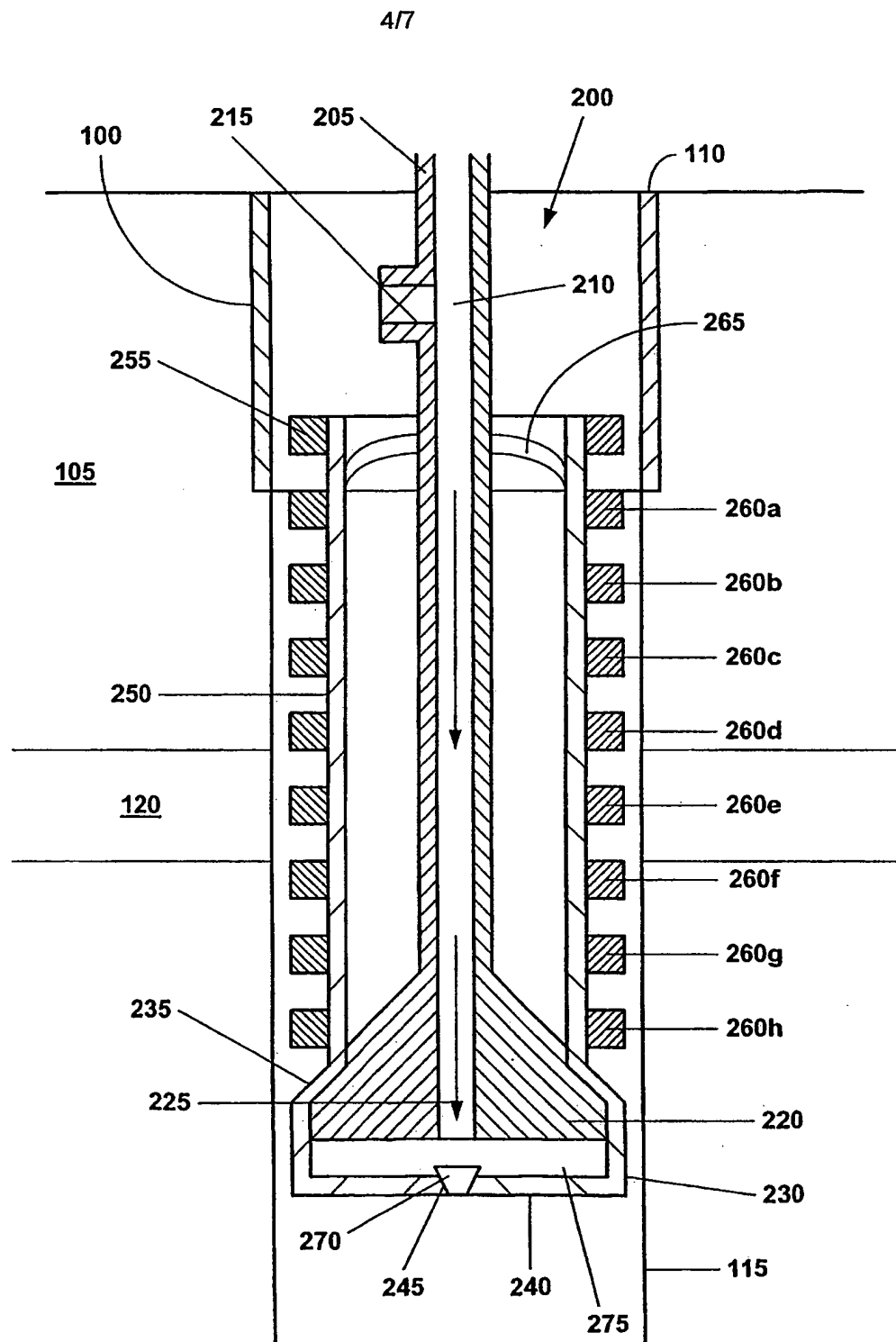


FIGURE 4

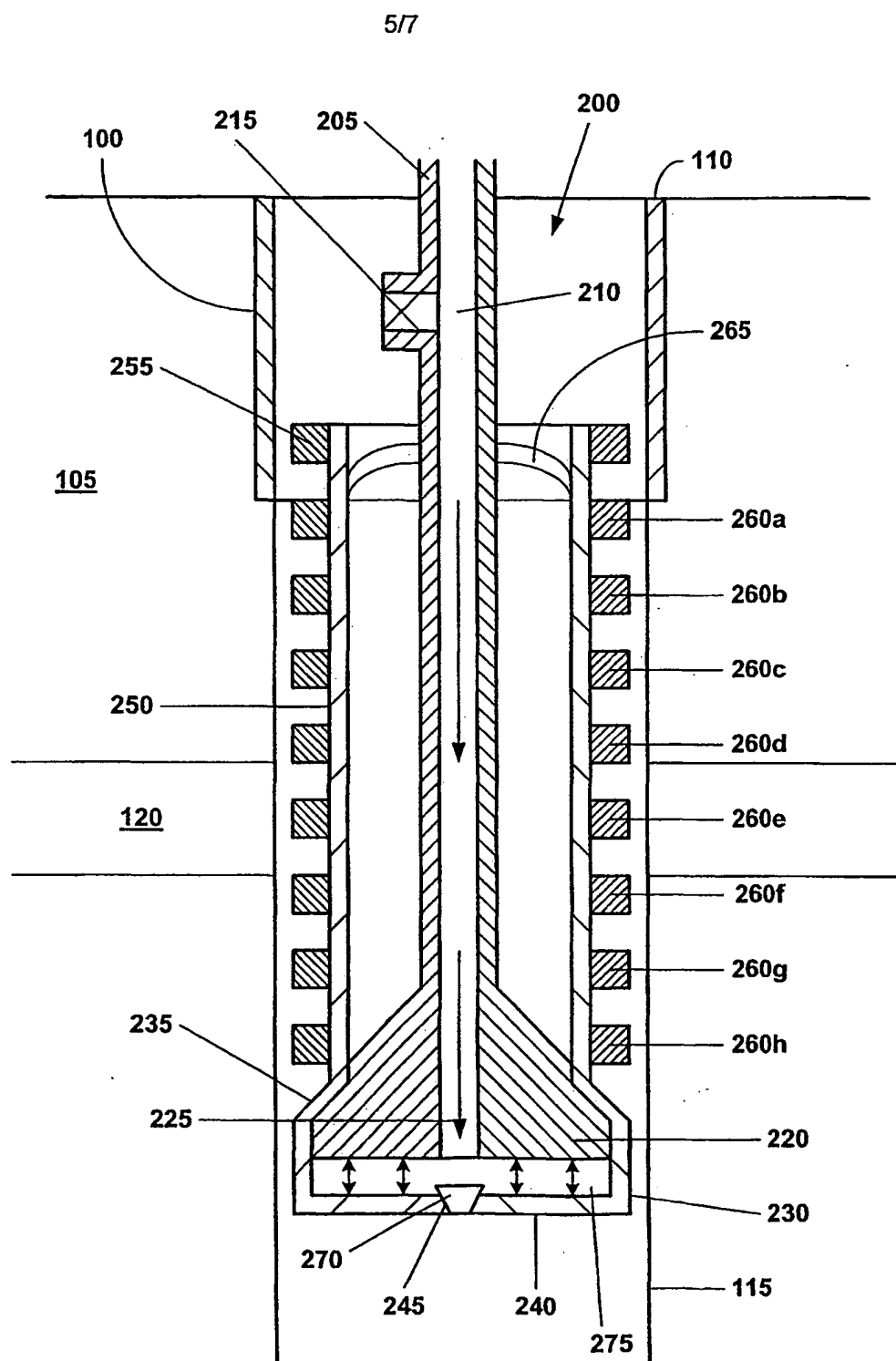


FIGURE 5

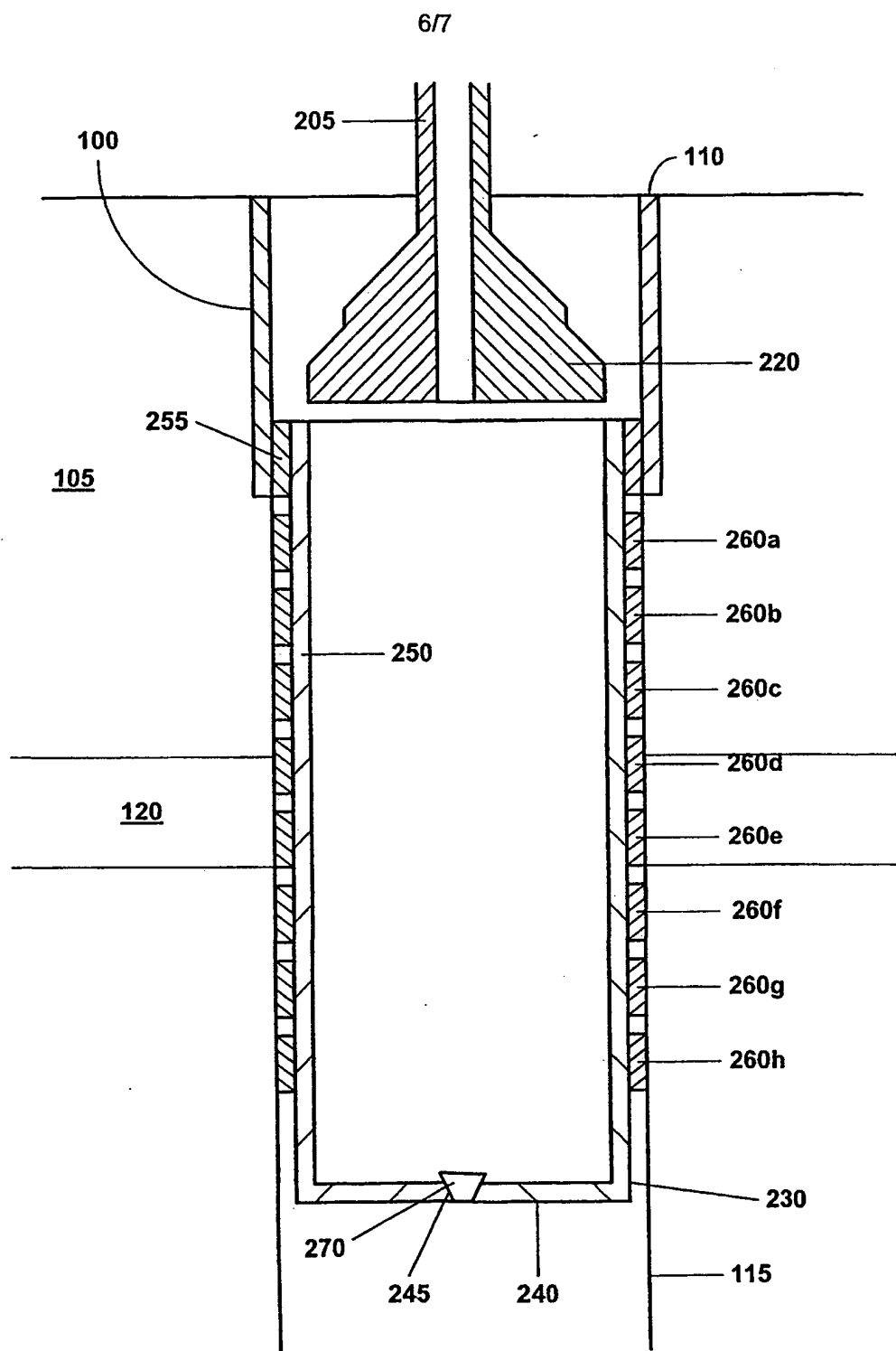


FIGURE 6

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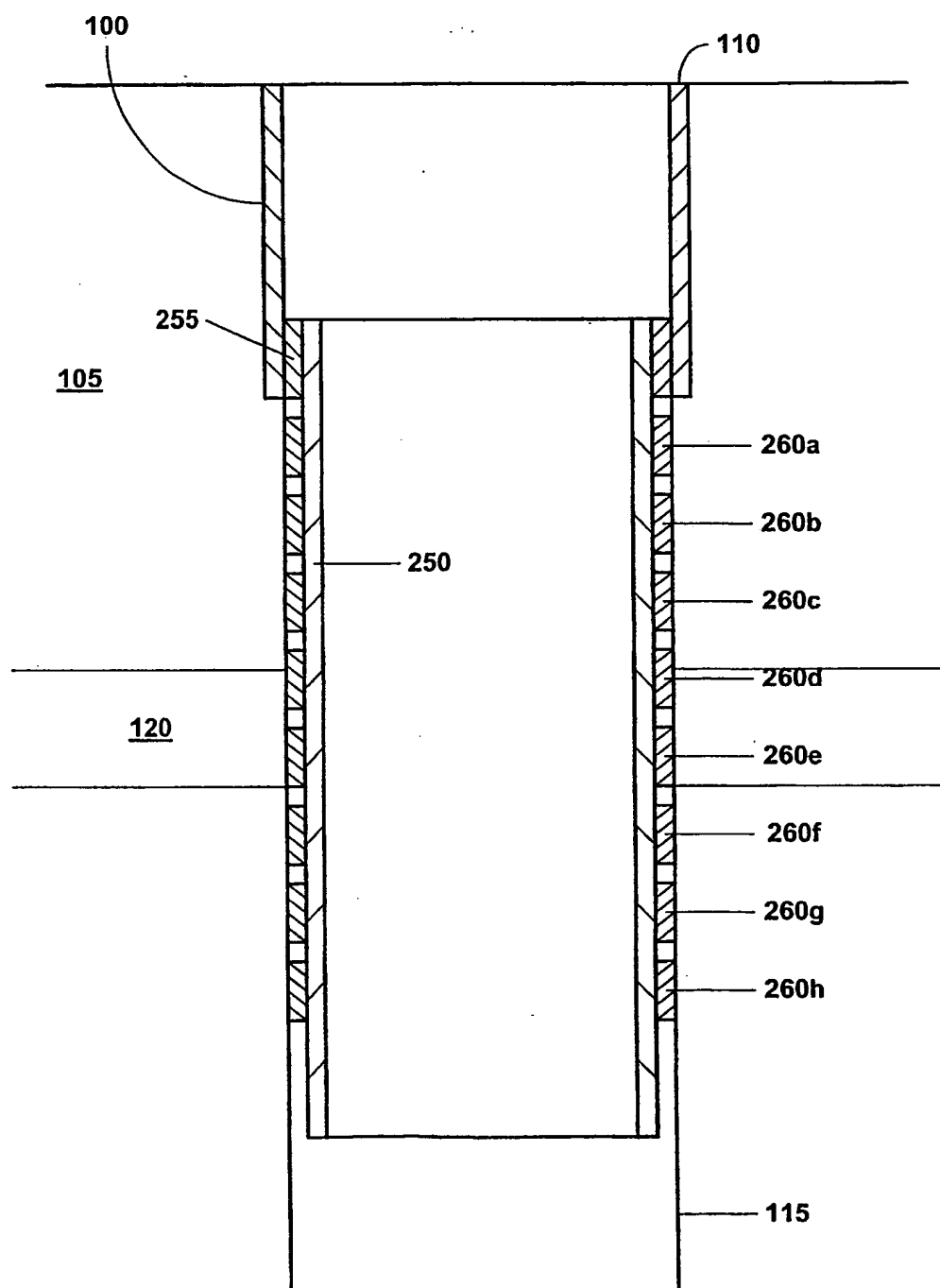


FIGURE 7

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/23815

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) : E 21 B 23/00, 23/08, 29/00

US CL : 166/ 207, 277, 383

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 166/ 207, 277, 381, 383

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
Please See Continuation Sheet**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,085,838 A (Vercaemer et al.) 11 July 2000 (11.07.2000), Figures 2, 5-7, column 4, line 59-61, column 7, lines 6-65.	1-7
X	US 3,353,599 A (Swift) 21 November 1967 (21.11.1967), Figures 3-5, column 3, line 63 - column 4, line 5, column 4, lines 21-45, column 5, lines 11-31.	1, 2
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Y		3, 5-7
Y	US 5,494,106 A (Gueguen et al.) 27 February 1996 (27.02.1996), Figure 5, 6, 6A, column 2, lines 53-54, column 4, lines 40-54.	3, 5-7
A	US 2,812,025 A (Teague et al.) 05 November 1957 (05.11.1957), whole document.	
A	US 2,796,134 A (Binkley) 18 June 1957 (18.06.1957), whole document	
A	US 6,012,522 A (Donnelly et al.) 11 January 2000 (11.01.2000), whole document	

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search

12 October 2001 (12.10.2001)

Date of mailing of the international search report

16 NOV 2001

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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/23815

Continuation of B. FIELDS SEARCHED Item 3:  
DERWENT, JPO, EPO

wellbore, well-bore, expand, expandable, tubular, screen, ridge, ring, seal, standoff, clasp, piston

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